and are equal for a considerable series of numbers. Hence it is plain that the logarithms of the differences of the successive reciprocals can be obtained by addition, and the calculation conducted in a tabular form. Suppose n to equal 62500, then will K equal 408 2330, and the calculation will stand thus:—

Numbers.		Logs. of Diff. of Reciprocals.	Diff. of Reciprocals.	Reciprocals.
	K=	408 2330		
62500		..	..	·00001600 0000000
	Diff. of logs.			
62499	139	408 2469	256004	0256004
98	139	2608	12	0512016
97	139	2747	20	0768036
96	139	2886	29	1024065
95	139	3025	27	1280102

" The reciprocals entered in the table are, of course,

1600 000, 1600 026, 1600 051, 1600 077,
1600 102, 1600 128, &c.

" In the same tabular calculation the reciprocals of the half and quarter numbers are found by simple multiplication.

" The chief merit of a work of this kind is, of course, accuracy. To secure this, every precaution seems to have been taken. 'To prevent error,' says Colonel Oakes, 'the co-logarithms were checked independently at each 50th term. In taking out the numbers, the progression of their differences was kept in view, so that no material error could occur. The summation of the differences was checked at every 10th term by a subordinate summation, and by comparison with Barlow's tables; and wherever the seventh figure could be uncertain, it was determined by actual division. Finally, every hundredth term was computed by division. The whole of the calculations were performed in duplicate, and when the proofs were set up from one manuscript they were read with the other; and second and third proofs were also each examined by addition of the printed differences, and by comparison with Barlow's table at each 10th term. Lastly, the proofs were again examined, and the whole table virtually recomputed by summation on the Arithmomètre of M. Thomas de Colmar.'

" It is proper to add that the work was undertaken at the suggestion of Professor De Morgan, who says that it is, as far as he knows, 'the largest which has ever been attempted,' and that 'it is a very useful table, and that its applications are far too little known and thought of.' "

CORRESPONDENCE.

ON MR. STEPHENSON'S THEORY OF OPTIONS.

To the Editor of the Assurance Magazine.

SIR,—As I think it possible that your readers may have had nearly enough of this subject, I will be as brief as I can in my reply to the two points raised in Mr. Stephenson's letter in the last Number of the *Journal.*

Mr. S. asserts that I have altered the conditions of his problem. This I deny. His formula is deduced upon the supposition that P_x is deposited at interest; and, therefore, *at the moment of death* there will be due to the depositor's estate P_x plus the interest accruing from the commencement of the year of death. But this is precisely the same thing as $P_x(1+i)$, or P_x with a year's interest, payable at the end of the year of death; which, in accordance with the usual practice, I assumed in my problem.

Mr. S. further states, that in my remark respecting the "value of the policy" the possibility of deteriorated health is left out of consideration. Quite true; it *is* left entirely out of consideration, along with everything else which has nothing to do with the question I have raised. Any reader who may have taken the trouble to follow my reasoning will have noted that I mention the "value of the policy" merely to account for the *possibility* of effecting the assurance without parting with the control over the premium, and will not need any further explanation of the sense in which the expression is used.

If, instead of stating his problem as he has—viz., "to find the premium" required for the assurance, with the option of withdrawal—Mr. Stephenson had simply undertaken *to show how the assurance might be effected* so as to reserve to the policyholder the control over the premium paid, he would have avoided laying himself open to the exception I have taken. His mode of stating the problem, however, showed clearly that his notions on the subject were radically wrong; that he supposed the option of withdrawal to be a benefit included, and charged for, in the premium; and if any further proof of this were required, it is amply supplied in his last letter.

One more shot—not at Mr. Stephenson (who is a stranger to me) but at his theory—and I shall trouble neither your readers nor myself any further with the matter. He says that the value of the annuity, with P_x returnable *at or before death* is $\frac{N_{x+n}}{(N_x-N_{x+n})i+D_{x+n}}$. This expression I have shown is the value of the annuity, with P_x, and a year's interest on it, returnable at the end of the year of death. But P_x with a year's interest at the end of the year of death, is equivalent to P_x with half a year's interest at the moment of death; so that, according to Mr. Stephenson,

1. A deferred annuity,
2. The return of the premium at death, and
3. The option of previous withdrawal,

are together equal in value to

1. A deferred annuity,
2. The return of the premium at death, and
3. Half a year's interest on the premium, at death.

Here, then, we have it at last. The option of withdrawing the premium any time *before death* (and before the expiration of n years), is equivalent to half a year's interest upon it payable *at death* within the same period!

I remain, Sir,

Your very obedient servant,

London, 1st November, 1865. W. M. MAKEHAM.